Improvements in or relating to bottle capping apparatus

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Applicant: UDEC LTD
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- european: B67B1/03; B67B3/00; B67B3/064
Application number: GB19630002610 19630121
Priority number(s): GB19630002610 19630121

Abstract of **GB1011782**

1,011,782. Applying sterilized closures. U.D.E.C. Ltd. March 12, 1964 [Jan. 21, 1963], No. 2610/63. Heading B8T. In a bottle capping apparatus the caps are sterilized by heat before entering the cap- applying mechanism, the cap-applying mech- anism, the cap applying mechanism and the bottle - supporting mechanism being disposed within an air-tight casing con- taining a sterile atmosphere. A mechanical feeding device 40 feeds crown caps singly and successively from a hopper 36 into a metal shoot 38. A rotatable burner tube 58 is arranged so that its burner orifices normally are directed towards said shoot, but should the caps become jammed in the shoot rotation is imparted to the tube through a linkage 61, Fig. 2, from a solenoid motor 63. The motor is controlled by a switch mechanism actuated by a sensing device comprising a light source 70 which shines a beam of light through the shoot so that a photo-electric cell receives a fluttering light signal as long as the caps are travelling through the shoot. In addition to the burner tube, sterilizing liquid may be introduced into the shoot so that the caps are flooded before reach- ing the heating zone. Alternatively, sterilizing liquid may be used without the burner. To prevent a cap from being fed by the shoot to the cap-applying mechanism should no bottle be on a bottle support 22, the curved portion 54 of each shoot is pivotally connected at 97 to the portion above it and means are provided for swinging the extremity of the portion 55 out of the path of a finger 81 which normally sweep through a groove in a scoop 64 and pushes caps successively up into holders 82. The means are conditioned by a sensing button arranged in a star-wheel which

feeds previously filled bottles on to the rotating supports 22, the button being depressed against the action of a spring when a bottle is present. A bottle is centralized with respect to the cap applying mechanism by means of two half collars 9a. On the bottle being raised by the support 22 the cap is forced upwards against a spring 83 into a multi- segment ring 84 having an internal conical face which contracts the corrugated cap rim in- wardly over the bottle neck. The burner and greater part of the shoot are disposed outside the air-tight casing, the lower part of the shoot extending in air-tight manner through the casing wall.

FIG. 2.

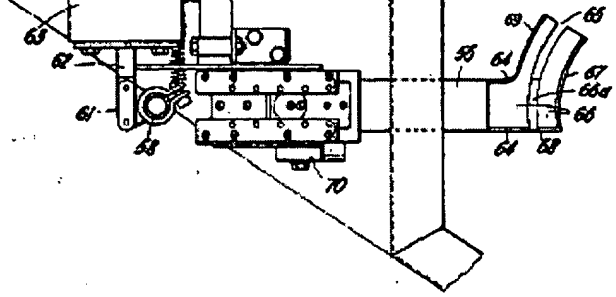
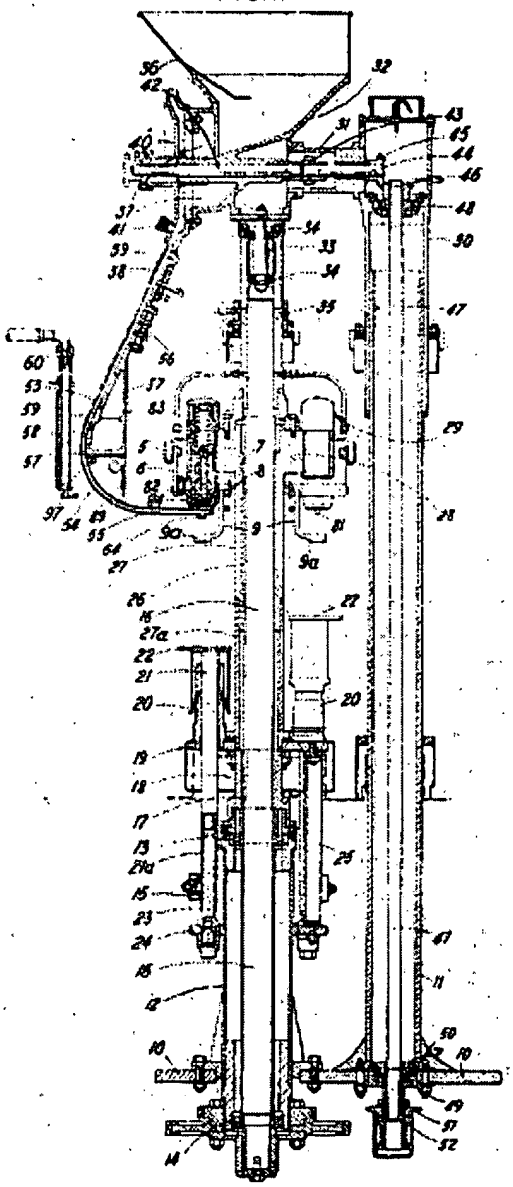


FIG. 1.



1,011,782

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,011,782

Inventor: ROWLAND SACKVILLE PRESTON ARBER

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Int. Cl.:—B 67 b

COMPLETE SPECIFICATION

Improvements in or relating to Bottle Capping Apparatus

We, UDEC LIMITED (formerly U. D. Engineering Co. Limited), a British Company, of Abbey Works, Cumberland Avenue, Park Royal, London, N.W.10, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described, in and by the following statement:—

This invention relates to bottle capping apparatus of the kind in which means are provided for applying caps successively to bottles which have been previously filled and for contracting rims on the caps around the necks of the bottles and is particularly applicable to caps known as crown caps.

According to this invention a bottle capping apparatus of the kind referred to is characterised in that the apparatus is disposed within a substantially air tight casing containing sterile atmosphere and in that a sterilising device is disposed outside said casing for sterilising the caps and in that means are provided for delivering the sterilised caps from the sterilising device through an opening in the casing to the capping apparatus.

The sterilising device may be associated with a chute through which the sterilized caps are fed through an opening in the casing to the capping apparatus. For example, the sterilising device may comprise a heater and/or means for applying sterilising fluid to the caps whilst travelling through the chute.

The heater may comprise a gas burner arranged to direct its flames on to a metal chute through which the caps are fed in succession to the capping apparatus.

The chute may be arranged to extend downwardly in a curved manner from a location where it receives the caps and its lower open extremity is disposed beneath the capping apparatus.

A magazine or hopper for the caps may be arranged at the upper end of the chute and a mechanical feeding device is arranged to feed the caps singly and successively from the magazine or hopper into the upper end of the chute.

In the case where the sterilising device comprises a burner, it is provided with a number of burner orifices disposed one above another directed towards said chute.

Means responsive to the movement of caps along the chute or in the feed of the chute may be arranged to render the burner inoperative upon the caps should no movement take place, and thus prevent the caps from being overheated.

The caps may be arranged to travel past a beam of light between a light source and a light sensitive cell, and said burner may be movably mounted so that in one position its burner orifices are directed towards the chute and in another position they are directed away from or clear of the chute, and means may be provided for moving the burner under control of said light sensitive cell.

The burner may comprise a straight burner tube vertically disposed and arranged to be rotatable about its longitudinal axis and provided with burner orifices along the length thereof, and said curved chute may be disposed in a vertical plane so that in one position the orifices lie in said plane and in another position are directed away from said plane.

The capping apparatus may comprise a number of cap applying mechanisms spaced apart around a circle on a rotatable head, each of which cap applying mechanisms has associated therewith a cap transfer device which during rotation of the head moves across the bottom of the chute and is adapted to impart movement to the lowest cap into or onto holding means in the cap applying mechanism, and which cap applying mechanisms, upon relative up and down movement between it and the bottle, presses the cap onto the neck of the bottle and contracts the rim of the cap thereonto.

The aforesaid transfer device associated with each cap applying mechanism may comprise a transfer finger fixed to the rotating head or to a part of the cap applying mechanism and which finger is arranged to enter a recess or groove in an inclined wall at the bottom of a scoop at the lower end of the chute, and to move a cap along the inclined wall whereby the cap is moved into or onto the aforesaid holding means.

Means may be associated with each cap applying mechanism for supporting a bottle beneath it and for locating the bottle so that its neck is aligned with the cap holding device.

Means may be provided for rotating the bottle supporting mechanism around the axis of said head and during rotation successively to raise and lower the support so as to bring a neck of a bottle into engagement with a cap in the cap holder and means are also provided which are brought into operation, consequent upon the upward movement of the bottle, to contract the rim of a cap around the neck of the bottle.

Means may be provided for aligning a bottle so that its neck is correctly positioned for engagement with a cap in the cap applying mechanism, which means comprise two downwardly extending arms associated with each cap applying mechanism and pivotally mounted on the rotatable head or on each cap applying mechanism so as to swing about an axis at right angles to the vertical so that the lower extremities of the arms move laterally towards and away from opposite sides of the neck of the bottle and means for imparting movement to the extremities of the arms towards the bottle just prior to the elevation of its bottle support, whereafter the arms are released.

In such an arrangement said arms are fixed to separate spindles rotatably mounted parallel to one another on the cap applying mechanisms, which spindles have fixed to them intermeshing pinions or toothed arcuate elements and one of which spindles has fixed to it an actuating lever having a cam follower at its extremity which is engageable with a stationary cam or the like as the head rotates, which cam is so located that the arms are brought together prior to the bottle being elevated and are then released.

Means may be provided for rendering the aforesaid cap transfer device inoperative should a bottle not be on a support.

For example, said chute may be movably mounted on the apparatus so that its lower end may be brought into and out of the path of said transfer fingers and is arranged normally to be in the former position and means may be provided for imparting said movement of the chute out of the path of the transfer fingers and which means are conditioned by sensing mechanism associated with a device for successively feeding bottles on to the bottle support which sensing mechanism is engageable by the bottles when present.

In such an arrangement the bottles may be successively fed on to the rotating assemblage of supports by a star wheel and each space between adjacent arms of the star wheel is provided with a sensing button which is depressed when a bottle enters the space and which button when not depressed has a part thereof which during rotation of the star wheel imparts movement to a transmission which moves the chute out of the path of movement of the fingers, but which button when depressed does not actuate said transmission.

The aforesaid chute may be mounted to rock about an axis at right angles to the plane containing its curvature so that its lower end is movable in an up and down direction and when in its lower position is clear of the path of movement of the transfer finger. In such an arrangement said cam may be mounted at the end of an arm fixed to a rock shaft so as to lie in the path of movement of said button, and which shaft is mounted in bearings on a fixer part of the apparatus and another arm on the rock shaft engages one end of another lever pivoted intermediate of its ends on a fixed part of the apparatus, the other extremity of which engages an abutment on the lower end of the chute so as to swing it against the action of a spring clear of the path of movement of said transfer fingers.

In any of the arrangements referred to above said cap applying mechanism and bottle supporting mechanism are arranged within a compartment having a sterile atmosphere and said sterilising device and the part of the chute with which it is associated is disposed outside the compartment and a lower part of the chute extends through the wall of the compartment into the sterile atmosphere.

The following is a description of one form of bottle cap steriliser reference being made to the accompanying drawing in which:—

Figure 1 is a vertical section through the apparatus;

Figure 2 is a plan view on an enlarged scale of the chute with the hopper removed;

Figure 3 is a plan view on an enlarged scale of the mechanism for deflecting the cap feed chute away from the cap applying mechanism when a bottle is not present;

Figure 4 is a section on the bent line 4—4 of Figure 3 certain parts being omitted; and

Figure 5 is a section on the bent line 5—5 of Figure 3.

Attached to the frame 10 of the apparatus are two vertical tubular supports 11 and 12. Mounted in housings at the top and bottom of tubular support 12 are bearings 13 and 14. Supported by the bearings is a vertical shaft 16 to which is keyed at 17 a sleeve 18 having attached thereto a table 19 provided with a number of vertical guides 20 distributed

around the shaft 16. Reciprocable in the guides are spindles 21 to the upper ends of which are secured bottle supports 22. The lower ends of the spindles are provided with tubular extensions 21a reciprocable on guide rods 23 secured to a ring 24 carried by a bracket 25 from the table 19. Each extension is provided with a roller 15 in engagement with a fixed cam track (not shown. Also keyed to the shaft 16 at 26 is a two part tubular member 27, 27a, having a head 28 at its upper end which carries a number of cap applying mechanisms indicated generally at 29. With this arrangement the cap applying mechanisms and the bottle supports 22 rotate together with the shaft 16.

Mounted at the lower end of each cap applying mechanism is a bottle locating device comprising two half collars 9a mounted on arms 9 fixed to shafts 8 geared together at 7 and one of the shafts has fixed to it an arm 6 having a cam follower 5 which engages a fixed cam track platform in a radial direction with respect to the axes of rotation of table 19 and parallel to the axes of the shaft 8 which results in the neck of the bottle passing in between the collars which at that time are separated. With continued rotation of the table 19, the cam is so shaped that the collars are brought together approximately centralising the bottle with respect to the cap applying mechanism. The collars are then freed and the bottle commences to rise and force the collars apart resulting in the final centralising of the bottle.

Also secured to the lower end of each cap applying mechanism on the trailing side thereof is a downwardly extending finger 81. Each cap applying mechanism comprises a cap holder 82 either in the form of a sucker or magnet which is movable in an up and down direction against the action of a spring 83 so that when a bottle is raised by the support 22 the cap is forced upwardly into a multi-segment ring 84 having an internal conical face whereby the corrugated rim of the cap is contracted inwardly over the neck of the bottle. The parts of the multi segment ring have a degree of freedom to prevent their locking on to the neck of the bottle. Upon downward movement of the bottle and the support 22 the spring 83 ejects the bottle and its cap from the multi segment ring 84.

The upper end of the other tubular support 11 has secured to it a casing 30 which in its turn has secured to it a branch casing 31 attached to a hopper mounting 32. The lower part of the hopper mounting has attached to it a spindle 33 mounted in bearings 34 within a sleeve 35 fixed to and rotating with the head 28. The upper part of the hopper mounting 32 supports a sheet metal hopper 36. The lower part of the hopper mounting is also shaped to provide an outlet passage 37 leading to the upper part of a chute 38 connected at 39 to the hopper mounting.

The passage of the caps from the hopper to the upper part of the chute is controlled by a rotary distributor disc 40 on which is mounted a number of spring pressed pointed plungers 41 which upon rotation of the disc ensure the caps being delivered successively or singly out of the hopper into the upper part of the chute.

The rotary distributor disc is secured to a spindle 42 which in its turn is secured by a coupling 43 to a further spindle 44 having a bevel gear wheel 45 meshing with another bevel gear wheel 46. The latter bevel gear wheel is fixed to the upper end of a shaft 47 supported by bearings 48 and 49 the former being mounted in the gear casing 30 and the further bearing being mounted in a housing 50 attached to the frame 10. The lower end of the shaft 47 has secured to it a sprocket wheel 51 through a slipping clutch 52 which wheel 51 is driven through a suitable transmission from the motor.

The rate of rotation of the distributor disc is such that it feeds caps into the chute at a slightly greater rate than they are withdrawn by said fingers 81 so that the chute is maintained full.

The upper part 38 of the chute is attached to a lower part 53 which extends downwardly and away from the shaft 16.

It's lower end is pivotally connected to a curved inwardly extending part 54 which terminates in a substantially horizontal part 55 which part is provided with a scoop like channel portion 64 beneath the path of travel of the various cap applying mechanisms.

As best seen in Figure 2 the scoop like channel portion 64 has a lateral opening 65 and a groove 66a in an inclined bottom wall 66 to form a ramp. The scoop portion is formed with upstanding flanges 67, 68 and 69. The flange 68 is provided with a slot opposite the end of the groove 66a. The arrangement is such that as the head carrying the cap applying mechanism rotates the aforesaid fingers 81 sweep through the groove 66a in the scoop and is arranged to push caps successively up the ramps on to or into the holders 82. The bottle is then raised, whereby the cap is pressed on to the mouth of the bottle and contracted around it. The upper and lower parts 38, 53 of the chute are secured by a plate 56 to a bracket member 57 on which is rotatably mounted a vertically disposed burner tube 58 so that at one limit of rotation its burner orifices 59 are directed towards the bend 54 in the chute, whereas at the other limit of movement they are directed away from the chute.

The upper end of the burner tube is supported by and is rotatably relative to an injector 60, and should the caps become jammed in the chute rotation is imparted to the tube through a linkage 61 from a plunger 62 of a

solenoid motor 63 see Figure 2 as described below.

Normally the flames from the burner play on to the chute continuously and maintain it at such a temperature that the caps are heat sterilized as they pass through it.

The solenoid motor 63 for applying rotational movement to the burner tube may be controlled by switch mechanism actuated by a sensing device comprising a light source 70 disposed to one side of the chute which chute is provided with openings on opposite sides through which the light beam passes and is reflected in to a photo electric cell.

The openings are so disposed that the path of travel of the caps like spaces between the adjacent caps cross the openings so that as long as the caps are travelling through the chute the light sensitive cell receives a fluttering light signal. Should however the caps jam in the chute the fluttering light signal will cease and the cell will receive either a constant light intensity or no light at all. An electric circuit of known kind is so associated with the light sensitive cell and solenoid motor that as soon as either of the above conditions takes place the motor is energised and rotates the burner so that its jets are directed away from the chute but as soon as there is again a travel of the caps through the chute the motor is de-energised and automatically returns the burner to its normal position where the orifices are directed towards the chute.

In place of or in addition to the burner tube, there may be provided means for introducing sterilising liquid into the chute for example there may be provided an injector which is driven from the aforesaid distributor disc. In the case where an injector is provided in addition to the burner it may be so disposed that the caps are flooded with the sterilising liquid before reaching the heating zone whereby the liquid will be evaporated when reaching that zone.

In order to prevent a cap from being fed by the chute to a cap applying mechanism should a bottle not be on a bottle support the curved portion 54 of each chute is pivotally connected at 97 to the portion above it and means are provided for swinging the extremity of the chute portion 55 out of the path of travel of the aforesaid finger 81 on the cap applying mechanism. These means are conditioned by a sensing device associated with the bottle feeding mechanism shown in Figures 3, 4 and 5. In this arrangement the bottles are successively fed on to the rotating assemblage of bottle supports 22 by a star wheel 71, each space 72 between adjacent arms 73 thereof is provided with a radially movable sensing button 74 arranged in a bore in the star wheel and which button is depressed against the action of a spring 86 when a bottle enters the space. Each bore intersects a circumferential groove 98 in a face of the star wheel.

The button is cylindrical in formation and its outer end is cut away at 76. When there is not a bottle in a space between adjacent arms of a star wheel, a part of the full circumferential portion of the button projects into the circumferential groove and is arranged, during the rotation of the star wheel to engage an arcuate cam plate 75 which also projects into the groove and is at the end of an arm 77 fixed to a rock shaft 78 which is mounted in bearings 79 on a fixed part of the apparatus. Another arm 80 on the rock shaft is provided at its extremity with a plate 87 carrying an adjusting screw 88 which engages one end of a lever arm 83 pivoted at 89 intermediate of its ends on a fixed part of the apparatus 90. The other extremity of the lever arm 83 engages an abutment 82 on the aforesaid scoop 64, which is spring urged at 89 (Figure 1) so as to maintain the engagement. Thus when no bottle is present the scoop is swung downwardly out of the path of movement of the finger 81. When however a bottle is present the button 74 is depressed bringing the path of movement of the cut away portion 76 opposite the cam 75 and thus swinging movement is not imparted to the arm 77 and the scoop 64 remains in the path of movement of the fingers 81 and caps are lifted successively into the cap applying mechanism. In order to prevent each spring pressed button 74 from urging a bottle radially outwards from the space between adjacent arms of the star wheel whilst it passes on to one of the bottle supports 22, a peg 94 on the opposite side of the button to the cutaway portion 76 is gathered up by the inner face of a fixed arcuate guide member 95, the peg passing clear of the guide member when the bottle has been passed to the support 22. The guide member may be provided with a metal nose piece 96.

The main part of the above apparatus including the support for the bottles and the mechanism which applies the caps to them is located within a substantially air tight casing having a sterile atmosphere the walls of which are indicated at 93 in Figure 3. The burner and the greater part of the chute are disposed outside the chamber and the lower part of the chute extends in an air tight manner through said wall. The chute may be electrically heated instead of being heated by a burner. Instead of the caps being sterilised by heat as they pass through the chute they may have sterilising liquid sprayed on during their passage through the chute or prior to their entry.

WHAT WE CLAIM IS:—

1. A bottle capping apparatus of the kind referred to characterised in that the part of the apparatus which supports the bottles and

applies caps to them is disposed within a substantially air tight casing containing a sterile atmosphere and in that a sterilising device is disposed outside said casing for sterilising the caps and in that means are provided for delivering the sterilised caps from the sterilising device through an opening in the casing to the capping apparatus.

2. A bottle capping apparatus according to claim 1 wherein the sterilising device is associated with a chute through which the sterilised caps are fed through the opening in the casing to the capping apparatus.

3. A bottle capping apparatus according to claim 2 wherein said sterilising device comprises a heater and/or means for applying sterilising fluid to the caps whilst travelling through the chute.

4. A bottle capping apparatus according to claim 3 wherein said heater comprises a gas burner arranged to direct its flame on to a metal chute through which the caps are fed in succession to the capping apparatus.

5. An apparatus according to any of claims 2 to 4 wherein said chute is arranged to extend downwardly in a curved manner from a location where it receives the caps and its lower open extremity is disposed beneath the capping apparatus.

6. An apparatus according to any of claims 2 to 5 wherein a magazine or hopper for the caps is arranged at the upper end of the chute and a mechanical feeding device is arranged to feed the caps singly and successively from the magazine or hopper, into the upper end of the chute.

7. An apparatus according to claim 4 and embodying the features of claim 5 or claim 6 wherein said burner is provided with a number of burner orifices disposed one above another and directed towards said chute.

8. An apparatus according to claim 7 wherein means responsive to the movement of caps along the chute or in the feed to the chute are arranged to render said burner inoperative upon the caps should no movement take place.

9. An apparatus according to claim 8 wherein the caps are arranged to travel past a beam of light between a light source and a light sensitive cell and said burner is movably mounted so that in one position its burner orifices are directed towards the chute and in another position they are directed away from or clear of the chute and means for moving said burner is controlled by said light sensitive cell.

10. An apparatus according to any of claims 7 to 9 wherein the burner comprsies a straight burner tube vertically disposed and arranged to be rotatable about its longitudinal axis and provided with burner orifices along the length thereof, and said curved chute is disposed in a vertical plane so that in one position the orifices lie in said plane and in another position are directed away from said plane.

11. An apparatus according to any of the preceding claims 2 to 10 wherein said capping apparatus comprises a number of cap applying mechanisms spaced apart around a circle on a rotatable head, each of which cap applying mechanisms has associated therewith a cap transfer device which during rotation of the head moves across the bottom of the chute and is adapted to impart movement of the lowermost cap into or onto holding means in the cap applying mechanism and which cap applying mechanism upon relative up and down movement between it and the bottle presses the cap on to the neck of the bottle and contracts the rim of the cap thereon.

12. An apparatus according to claim 11 wherein said transfer device associated with each cap applying mechanism comprises a transfer finger fixed to the rotating head and which finger is arranged to enter a recess or groove in an inclined wall at the bottom of a scoop at the lower end of the chute and to move a cap along the inclined wall whereby the cap is moved, into or onto the aforesaid holding means.

13. An apparatus according to claim 11 or claim 12 wherein means are associated with each cap applying mechanism for supporting a bottle beneath it and for locating the bottle so that its neck is aligned with the cap holding device.

14. An apparatus according to claim 13 wherein means are provided for rotating the bottle supporting mechanism supports around the axis of said head and during rotation successively to raise and lower the supports so as to bring a neck of a bottle into engagement with the cap in the cap holder and wherein means are also provided which are brought into operation, consequent upon upward movement of the bottle to contract the rim of the cap around the neck of the bottle.

15. An apparatus according to claim 13 or claim 14 wherein means are provided for aligning a bottle so that its neck is correctly positioned for engagement with a cap in the cap applying mechanism, which means comprise two downwardly extending arms associated with each cap applying mechanism and pivotally mounted on the rotatable head or on each cap applying mechanism so as to swing about an axis at right angles to the vertical so that lower extremities of the arms move laterally towards and away from opposite sides of the bottle neck and means for imparting movement to the extremities of the arms towards a bottle just prior to the elevation of its bottle support whereafter the arms are released.

16. An apparatus according to claim 15 wherein said arms are fixed to separate spindles rotatably mounted parallel to one another on each of the cap applying mechanisms which spindles have fixed to then intermeshing

pinions or toothed arcuate elements and one of which spindles has fixed to it an actuating lever having a cam follower at its extremity which is engageable with a stationary cam or the like as the head rotates, which cam is so located that the arms are brought together prior to the bottle being elevated and are then released.

17. An apparatus according to any of the claims 12 to 16 wherein means are provided for rendering the aforesaid cap transfer inoperative should a bottle not be on a support.

18. An apparatus according to claim 17 wherein said chute is movably mounted on the apparatus so that its lower end may be brought into and out of the path of said transfer fingers and is arranged normally to be in the former position and means are provided for imparting said movement of the chute out of the path of the transfer fingers which means are conditioned by sensing mechanism associated with a device for successively feeding the bottles on to the bottle supports and which sensing mechanism is engageable by the bottles when present.

19. An apparatus according to claim 18 and where the bottles are successively fed on to the rotating assemblage of supports by a star wheel, wherein each space between adjacent arms of the star wheel is provided with a sensing button which is depressed when a bottle enters the space and which button when not depressed has a part thereof which during the rotation of star wheel imparts movement to a transmission which moves out of the path of movement of the transfer fingers but which button when depressed does not actuate said transmission.

20. An apparatus according to claim 19 wherein said chute is mounted to rock about an axis at right angles to the plane containing its curvature so that its lower end is movable in an up and down direction and when in its lower position is clear of the path of movement of the transfer fingers.

21. An apparatus according to claim 20 wherein a cam is mounted at the end of an arm fixed to a rock shaft so as to be in the path of movement of said button and which shaft is mounted in bearings on a fixed part of the apparatus and another arm of the rock shaft engages one end of another lever pivoted intermediate of its end on a fixed part of the apparatus the other extremity of which engages an abutment on the lower end of the chute so as to swing it against the action of a spring clear of the path of movement of said transfer fingers.

22. An apparatus according to any of the preceding claims 13 to 21 wherein said cap applying mechanism and bottle supporting mechanism are arranged within a compartment having a sterile atmosphere and wherein said sterilizing device and a part of the chute with which it is associated is disposed outside of said compartment and wherein a lower part of the chute extends through a wall of the compartment into the sterile atmosphere.

23. A bottle capping apparatus embodying a heat sterilizing device for the caps substantially as described with reference to the accompanying drawings.

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Agents for the Applicants.

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1011782 COMPLETE SPECIFICATION

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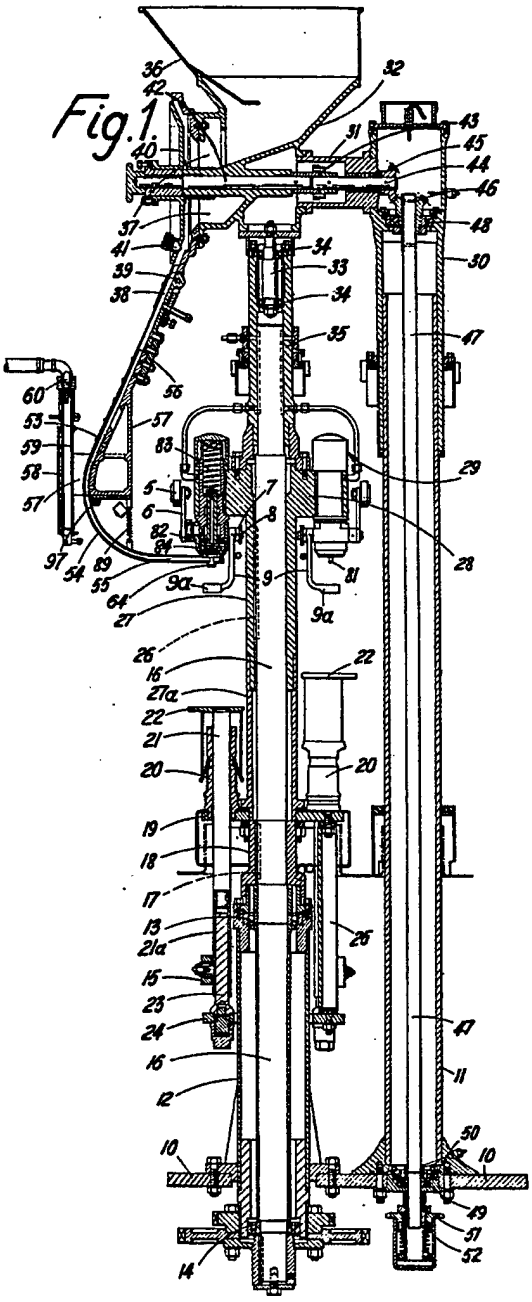
Sheet 1

Fig. 1.



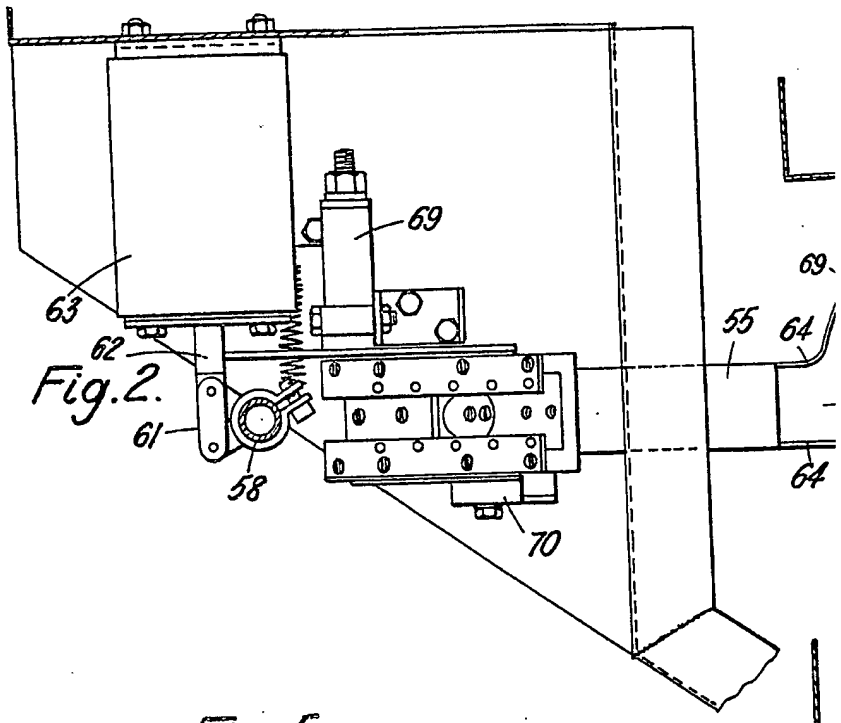


Fig. 2.

Fig. 5.

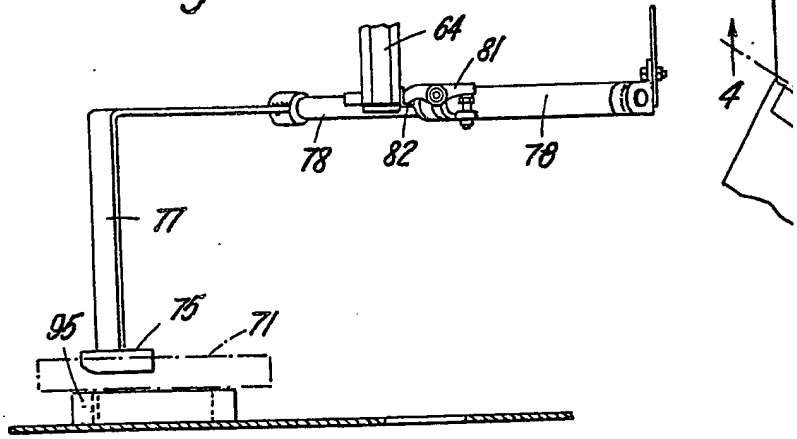


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Fig. 4.

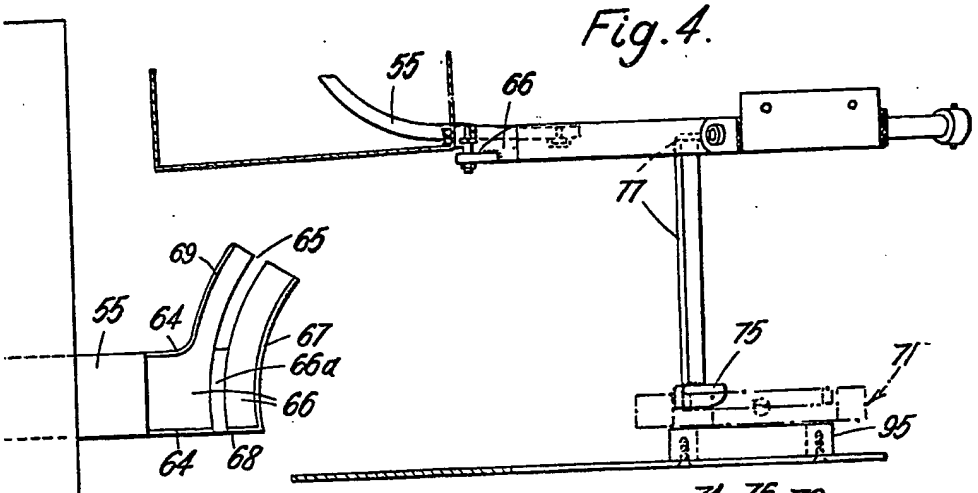
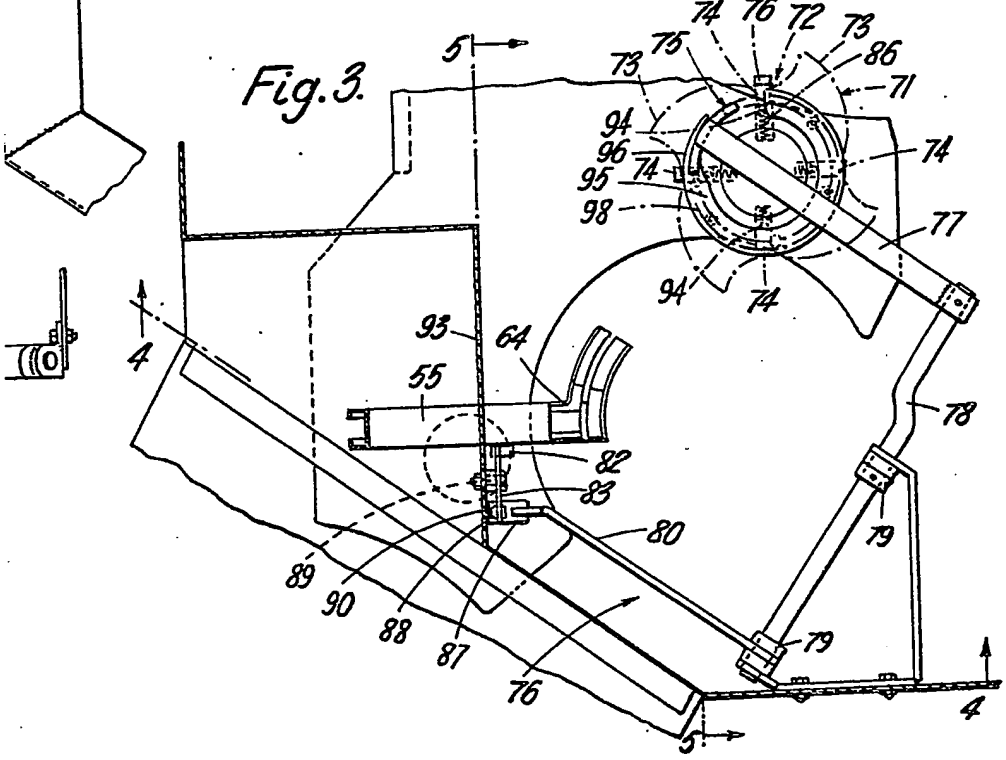


Fig. 3.



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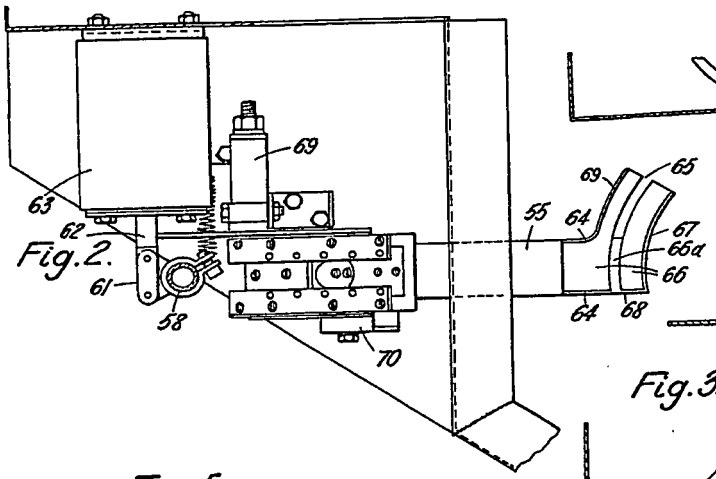

Fig. 2.

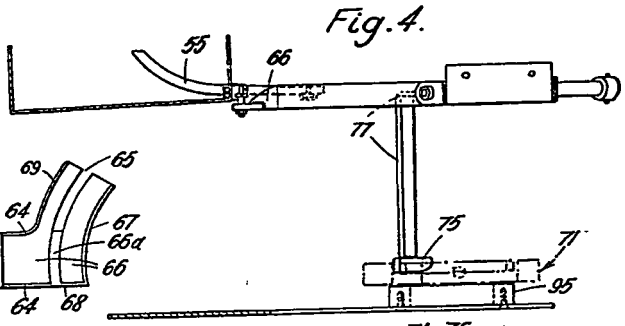

Fig. 4.

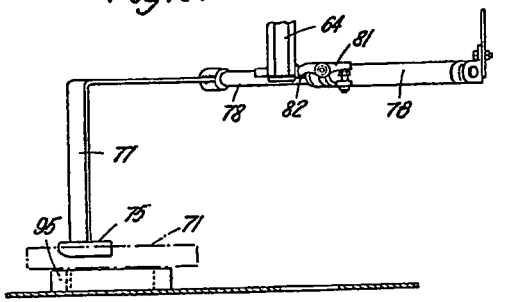

Fig. 5.

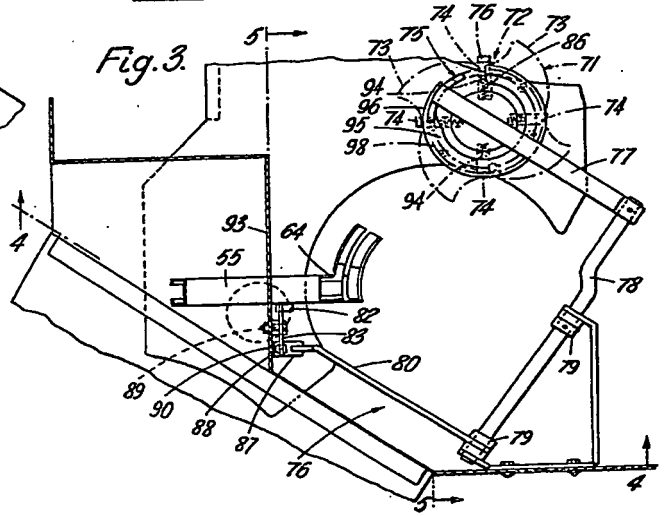

Fig. 3.

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